TWENTY-THIRD ANNUAL REPORT 1949

CENTRAL STATES
FOREST EXPERIMENT STATION
Columbus 15, Ohio

Harold L. Mitchell, Director

CONTENTS

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1949

INTRODUCTION

At a year's beginning, I always take a long, hard look at the goal toward which we as a forest research organization are heading. Then I review our effort of recent months and years to check on progress and to make sure that our aim is reasonably good.

Our Station territory includes the heart of the hardwood-producing area of the nation. In addition to producing high-quality cabinet hardwoods, the region contains a great variety of wood-using industries and is probably the nation's greatest consumer of hardwood lumber.

Roughly half of the Central States territory is in the rich, gently rolling Cornbelt. Here the forest, which is found on less than ten percent of the land area, is largely made up of small, scattered farm wood lots. The economy is dominated by corn-hog agriculture and industry. Most of the remainder of the Central States territory is in the Missouri Ozarks, the rough, unglaciated lands along the Ohio River, and the mountainous sections of Kentucky. Here forest and potential forest lands predominate, and forestry and allied uses are of major importance to the local economy. For this large and diversified territory we aim to help solve the problems of timber growing, harvesting, processing, and marketing; and the problems related to sound forest-range use and to effective water conservation.

Our approach to the solution of some of these problems must be different in the Cornbelt than in the more heavily forested hill country to the south. Moreover, in deciding where and on what forest problems to concentrate we must carefully weigh such factors as the extent, character, ownership, and current management of present and potential forest land; the importance of forestry to the local economy; trends in land use, population, and industrial development; the research and action programs of other forestry agencies; and especially the needs of the owners and managers of forest and forest-range lands. These and other factors, such as commitments to Congress, have been considered in developing the Station's present research program.

There is also the question of determining the most efficient type of organization for attacking a particular problem. Many forest problems are regional and interstate in nature. Accordingly, research thereon is

best organized on a regional basis. Experience has shown, for example, that for maximum efficiency such activities as the Forest Survey and flood control surveys should be handled by a small staff of specialists working out of the Station headquarters, together with mobile field crews moving from state to state or watershed to watershed as the work progresses. Most major problems in forest, range, and watershed management are also regional and interstate in nature, but may have local aspects requiring year-around, on-the-ground study. This requirement is satisfied through such organizational devices as research centers and experimental forests. Correlation of such research on a regional or forest-type basis is provided by the central office, together with the help of such specialists as the field units may need to solve local aspects of broad problems. Purely local forest problems, problems other agencies are better equipped to deal with, and research having limited application, are best handled by or in cooperation with the state agricultural experiment stations or other local research organizations.

We have made some progress. Four research centers, four experimental forests, and numerous smaller experimental areas have been established at strategic locations throughout the region, the majority in the more heavily forested sections, Studies designed to determine and demonstrate the biological success and financial feasibility of different systems of management, silvicultural practices, and utilization methods are under way in several of the major forest-soil types of the Central Hardwood region. These long-range studies have started to pay dividends. A well-equipped laboratory was recently established at our Buckeye Branch, and a start made on fundamental research in soils, tree physiology, and forest influences. During 1949 we initiated forest-range research in the Missouri Ozarks. Regional studies on spoil-bank reclamation have provided an increasing amount of information on the extent, character, and forestation possibilities of lands stripped for coal.

Since 1946, our unit of the nation-wide Forest Survey has covered an estimated 70 percent of the forest area in the Station territory, and has thus provided accurate information on the forest area, timber volume, and timber growth; and on the rate of cutting and timber loss from diseases, fire, and other natural causes. We have also made progress on flood control surveys and in the fields of marketing and utilization.

But we still have much to do. Forest Survey information is proving beyond question that the timber stands of this region are, in the main, badly understocked and that much of the present volume is either in species or qualities for which there is limited present demand. We need to develop practical, financially feasible ways of rebuilding the growing stock, improving the composition, and increasing the growth of these stands. Then there is the problem of reclaiming spoil banks and of planting the several million acres of marginal or idle agricultural land for which forestry appears to be the highest use. We need to know more about the species best suited to various conditions of soil and climate, and we need to develop more efficient methods and equipment for planting and seeding such sites.

There is much to be learned about forest-range grazing in the Missouri Ozarks. In connection with our flood control activities there is an urgent need for information on the influence of forest-cover types and management practices on the rebuilding of exhausted soils, soil stabilization, and the retention and movement of water. Despite the need, there is still no fire research in the Central States. We need more work on the development of new uses and markets for the low-quality trees and low-value species that make up most of the volume in our present stands. There is need for more efficient logging methods and equipment, especially for light mechanized equipment suitable for use in farm wood lots. Beyond all this we need to learn how to market woodland products so that the landowner can know the quality of his timber, the use or uses to which it can best be put, and the location of buyers interested in acquiring the kind of product he has to sell.

We have made progress; the progress of the past year is spelled out in some detail in the remainder of this report. We propose to move forward in the directions I have already indicated. Our more detailed plans for the coming year are also presented in the remainder of this report.

HAROLD L. MITCHELL
Director

FOREST ECONOMICS

FOREST SURVEY

Progress and accomplishments in 1949

Missouri.--The final draft of the analytical report on the forest situation in Missouri was completed during the year. This report is being published by the Agricultural Experiment Station of the University of Missouri under the title "Forest Resources and Industries of Missouri." The report shows that although more than one-third of Missouri is forested, the average volume per acre of timber on commercial forest land is only 789 board feet or about one-fifth of the volume that could be grown. At least 30,000 man-years of labor was expended in Missouri in 1946 in harvesting and processing logs and bolts valued at 42 million dollars. Both employment and value of product could be substantially increased by good management of the state's timber resources.

Comparisons of growth and drain on forest growing stock show that the volume of saw timber is slowly increasing for the state as a whole but that serious overcutting occurs in many areas. A five-point forest restoration program is recommended for improving Missouri's forest resource.

1. Protect the forest, especially from fire and grazing damage.

2. Increase the timber volume and the proportion in large, high-quality trees.

3. Develop better marketing practices and increase utilization of waste and low-grade woods.

4. Expand public ownership of forest lands not suited for private ownership.

5. Intensify research to learn how best to handle forest lands for maximum timber and forage production, watershed protection, and financial returns.

Illinois.--The inventory computations for the State of Illinois were completed during the year. The forest area and timber volume statistics for each of the three forest regions and for the state as a whole were published in June, 1949. The final figures showed a forest area for the state of 3,996,000 acres and a saw-timber volume of 10.3 billion board feet. The average volume per acre for all commercial forest land was 2,603 board feet.

During the year the data for the southern 16 counties in Illinois were compiled, and tables were prepared showing for each county the commercial forest area and the board-foot volume by major species groups. The intensification of field work that permitted reasonably accurate

county figures of timber volume was made possible through the cooperation of the Illinois Agricultural Experiment Station and the Illinois Division of Forestry which provided additional field personnel for this purpose.

The drain computations for Illinois were also completed during the year. Subject to final check, the results show that the 1947 cutting drain on trees of saw-timber size amounted to 141 million board feet of which 93.7 million board feet or 68 percent was cut for lumber. Other major drain items were cooperage (13 percent), fuelwood (8 percent), and veneer (8 percent). The cubic-foot drain from all sound, living trees was 34.5 million cubic feet with lumber accounting for 42 percent, fuelwood 26 percent, cooperage 8 percent, and veneer 5 percent.

The growth computations for Illinois have been completed. They show an annual growth for the state of 407 million board feet or 102 board feet per acre. Preliminary analysis of the growth-drain relationship indicates a considerable margin of growth over drain for the state as a whole.

Kentucky.--Inventory field work began in Kentucky in 1948 and was continued until December 1949. At that time all of the state, excepting the eight southeastern counties, had been covered--an estimated forest area of 9-1/2 million acres or 85 percent of the forest land of the state. The eight uncompleted counties, including some of the most rugged and inaccessible parts of the Appalachian range, have never been covered with aerial photography. In the fall of 1949, however, a cooperative agreement was made with the State of Kentucky and the Aerial-Photo Engineering Section of the Production and Marketing Administration to fly this area in the spring and summer of 1950. Because aerial photos are particularly valuable in determining forest area and in classifying timber stands in such rough topography, the inventory field work in the eight counties has been suspended until photos are available.

Computation of inventory data for the two western survey units was completed during the year, and the first draft of a release showing forest area and timber volume was prepared for one of these units. In this unit the sampling intensity was increased through the cooperation of the TVA Division of Forestry Relations, the Kentucky Division of Forestry, and the Kentucky Extension Service. Consequently, the accuracy of the inventory data was such as to permit computation of commercial forest area and timber volume for individual counties. The inventory field data for the central Kentucky survey units were checked and transferred to tabulating machine cards during the year, and plans were made to machine tabulate the data early in 1950.

During 1949, field work was completed on a survey to determine the volume of timber cut in Kentucky in 1948.

The volume of timber cut for lumber production was obtained by a three-phase program as follows:

1. The 1948 production of all large sawmills (those reporting at least one million board feet cut in 1947) was obtained by letter request or by personal interview.

2. A 100-percent canvass of all small mills in the 10 extreme western counties was made by the TVA Division of Forestry Relations in cooperation with the Central States Station.

3. The production of small mills in the remainder of the state was obtained by a sampling survey in which 12 counties, statistically weighted on the basis of their 1947 small-mill production, were randomly selected for complete canvass. The production of all small mills in these counties was obtained by personal interview. The 1948 production in these counties was compared with the production in 1947 as reported to the Bureau of the Census. The ratio of change of production in the sample counties was applied to the 1947 production to obtain total 1948 small-mill production.

By the above procedure the estimated 1948 lumber production was 559 million board feet. The sampling error of this estimate is 5.8 percent at a level of one standard deviation.

To determine the volume of timber cut for fuelwood, fence posts, and miscellaneous farm use, a sampling procedure based on the Master Sample of Agriculture was used. Production reports were obtained by interviewing all farmers and other woodland owners in 91 sample areas randomly selected from segments of the Master Sample. The volume cut in the entire state will be obtained by applying appropriate "blow-up" factors to the volume reported on the sample areas.

Production of other forest products such as cooperage stock, veneer, pulpwood, and handle stock was obtained by interviewing operators and primary consumers in Kentucky and adjoining states.

By the end of the year all of the field data on timber cut were collected and the computations were approximately half completed.

Basic analysis of growth measurements of sample trees was begun during 1949 for that portion of the state covered by the field inventory. Final growth estimates for the entire state cannot be prepared until inventory work is completed in the eight eastern counties.

Indiana.--After several conferences with state and private agencies in Indiana that are interested in obtaining up-to-date forest statistics, a mutually satisfactory procedure was developed and inventory field work was begun in southwestern Indiana early in December 1949. By the end of the year photo interpretation and field cruising had been completed in six counties.

General.--During the year the survey provided information and technical advice to a number of agencies and individuals interested in forest development in the Central States. In cooperation with other agencies in Ohio, it supported a program to obtain an aerial-photo reflight for the entire state. During 1949 the Ohio legislature appropriated $50,000 for this purpose, and a contract was made with the Production and Management Administration to complete the reflight of the state in 1950. The survey staff was instrumental in obtaining a similar agreement in Kentucky to obtain aerial photographs of the eight eastern counties previously unflown.

Forest Survey staff members assisted officers of the Shawnee and Wayne National Forests in working out the statistical design for large-scale timber surveys. At the request of industries and individuals, information was provided regarding the volume, quality, and availability of standing timber in specific areas.

The Photo Interpretation Section of the Forest Survey developed new aids and techniques in adapting aerial photographs to forestry use. These include a rapid method of determining slope percentage from aerial photos and tables for determining the board-foot and cubic-foot volume of standing trees from photo measurements. At the request of other divisions of the Forest Service, detailed photo examinations were made of several large areas of forest land to provide basic data on forest area, timber stand conditions, and volume. The Section also trained 11 foresters from state and federal agencies in the use of aerial photographs.

Plans for 1950

In 1950 Forest Survey field work will be concentrated in the State of Indiana. Inventory field work will cover the southern counties in the winter and spring and will swing north through the Cornbelt in the summer. Present plans call for completion of inventory work in the state in 1950.

A drain survey will also be made in Indiana in 1950 to obtain a record of the volume of timber cut. The volume of timber used for lumber, fuelwood, and fence posts will be obtained by sampling procedures, similar to those used in Kentucky. Reports from other industries will be obtained by a 100-percent canvass of producers, processors, or consumers.

The 1950 program of the computing section provides for completing the inventory tabulations of the central Kentucky survey units and for preparing standard tables of area and volume for each unit. The inventory data for the southern Indiana units will be transferred to punch cards and will be tabulated during the year. Drain computations for Kentucky will be finished early in 1950, and those for Indiana will be started as soon as drain field work is completed.

The analytical report on the forest resources and industries of Illinois will be completed in 1950. Statistical releases will be published for the Kentucky survey units in which inventory work has been completed.

MARKETING FARM WOODLAND PRODUCTS

Progress and accomplishments in 1949

Missouri.--During 1949, field work on the study of the marketing practices followed in a 6-county area in the Ozarks was completed. Some of the results of this study were published as Station Notes, and a list of the primary forest-product users and buyers in the study area was prepared. The list was duplicated and distributed to those interested in the marketing of forest products in that area. An office report describing the marketing situation in the study area and proposing improvements has been written and after appropriate revision will be published as a Station Technical Paper.

One phase of the above project included sawing-time studies at four Ozark sawmills and showed that mill operators can increase lumber production by sawing only logs of the larger diameters. For example, when the mills sawed lumber from logs that averaged 15 to 16 inches in diameter, they produced 60 percent more lumber per hour than when they sawed lumber from logs averaging 5 to 6 inches in diameter. The results indicate that if sawmill operators cut chiefly larger logs they could either reduce their production costs and selling prices, or they could increase the price they pay for logs or stumpage.

Another phase dealt with the marketing of white oak as stave bolts and as stave stumpage. This study investigated the general specifications for stave-quality trees and for stave bolts. It focused the attention of farm woodland owners on this profitable market for white oak of stave quality.

The survey of markets and marketing practices in six counties in the Missouri Ozarks also showed that markets for most forest products are fairly well developed, and that farm woodland owners have some choice in selecting both the method of selling their timber and the market for it. However, because so much of the timber is of poor quality and in scattered stands, the average woodland owner must market his timber by the best possible method and to the highest-paying market to insure a profitable timber sale.

Often timber owners do not select the best market for their forest products. Many of them are not adequately informed regarding available markets, or they are inexperienced in selling timber. Some buyers purchase and manufacture timber that could be used for a higher-quality product if the owner and buyer were able to recognize this quality. Only a few finished wood products are manufactured in this area; rather the semifinished products are shipped for further processing to plants located outside the area.

The study indicates that the more important means of improving the marketing situation are:

1. By extension and educational activities to show the timber owners and operators that they can increase their income by using improved harvesting and marketing methods.

2. By research to determine new uses for low-quality timber and the best methods of harvesting and marketing this type of timber.

3. By judicious expansion of the wood-using industries to insure full utilization (but not overutilization) of the timber resource and to increase remanufacturing in the area.

Illinois.--Following a conference in April, 1949, with various persons interested in forest-products marketing in southern Illinois, a marketing research project was initiated for that area. The objective of the study is:

1. To determine the importance of the contribution of the present forest resource and wood-using industries to the local economy.

2. To appraise the present timber resource in order to determine if the quantity and quality are sufficient to provide for expansion of present wood-using industries or the development of new ones.

3. To gather information concerning the kind, location, and requirements of present wood-using industries drawing upon the timber resources of southern Illinois.

Work on the project thus far has included field work to develop a list of wood-using markets drawing upon the southernmost 16 counties of Illinois, and the study of various existing reports and data files (including the Forest Survey, 1945 Census of Agriculture, 1947 Census of Manufacture, and 1948 Census of Wood Used in Manufacture) to determine facts pertinent to the marketing of forest products in southern Illinois. Wood-using plants of the area were located, and their kind, character, and timber needs were determined. A few industry leaders also were visited to obtain information on local marketing problems from industry's viewpoint. The field work brought out the following points:

1. A considerable quantity of lumber of the same species and quality that could be supplied by southern Illinois producers is being imported from other states for remanufacture in this area.

2. There is a trend toward the return of concentration yards in this area.

3. High cost of living and high wage rates through the oil- and coal-producing areas discourage activity in wood-using industries.

4. The best wood-using markets are along the Ohio and Mississippi Rivers.

5. There is in this area a lack of industries that can use large quantities of hickory and low-quality hardwood logs.

6. The market for soft hardwood logs for container veneer stock is good throughout most of the area. Based upon the volume and value of the logs required, the lumber industry ranks first in this area and the container-veneer industry second.

Study of various existing reports and data files has brought out the following preliminary information:

1. About 75 percent of the forest land of this area is on farms.

2. Only about 4 percent of the farmers having woodlands made any sales of wood products in 1945, according to the Census of Agriculture. These sales amounted to only about 1 percent of the cash farm income for that year.

3. Based upon the value of primary products produced from the various resources of southern Illinois, forest products rank about fifth.

4. Based on number of plants, wood-using industries rank second in the area according to the 1947 Census of Manufacture.

5. The forest growing stock showed a net increase for 1947 of approximately 3 percent of the pole-timber volume and approximately 2 percent of the saw-timber volume. Accordingly, the pole-timber volume increased over 7 million cubic feet, and the saw-timber volume, nearly 53 million board feet. It is of interest that the report by Miller, Chapman, and Telford on a forest survey of Illinois in 1924 shows an average volume of about 1152 board feet per forest acre for the southern-most 16 counties. This is in contrast with an average volume of approximately 2527 board feet per forest acre in 1948. Comparison of the board-foot volume in 1924 and in 1948 indicates that the average increase above cutting drain and mortality has been about 52 board feet per acre per year.

6. The supply of handle-stock wood is increasing rapidly. The increase of hickory and ash pole-timber volume amounted to nearly 3 million cubic feet, almost 5 percent of the net growing-stock volume of these species. This increase was greater than for any other species group.

7. Although the container-veneer industry draws heavily on the soft hardwoods, this species group still made the greatest net increase by volume in the saw-timber stands. This increase amounted to over 16 million board feet, about 2-1/2 percent of the net volume of growing stock in this species group.

8. On the basis of preliminary analysis of 1947 growth and drain data, it appears that the growth of high-quality logs is sufficient to meet the needs of present industry for high-quality material of all species except the white oak group.

Plans for 1950

Missouri.--The marketing report on the six Ozark counties will be published. Tentative arrangements have been made with the Missouri Division of Resources and Development for a cooperative marketing study in the pine portion of the Ozark region. A working plan will be prepared and the study begun when arrangements have been completed. The study will be designed to determine: (1) if the shortleaf pine timber in the Missouri Ozarks has the volume and character to support the development of new markets for pine, such as a pulpmill, a post-treating plant, or a pole-peeling and -treating plant; (2) if the marketing of pulpwood, posts, and poles is economically feasible in this area; and (3) the consumer attitude toward the purchase of treated pine posts in logical marketing areas for posts from the Ozarks.

Illinois.--The "List of Wood-using Markets Available to Southern Illinois" will be duplicated and sent to state and federal employees for corrections, additions, and comments. The list will be revised and perhaps issued as a Miscellaneous Station Release.

Based upon data gained from a number of sources, including the Forest Survey, Census of Agriculture for 1945, other Census reports, the "Southern Illinois" report, and field observations, a technical paper or its equivalent will be prepared which will (1) show whether or not the present and potential timber resource of southern Illinois is of sufficient quantity and quality to sustain permanently an expanded or more diversified local forest industry, (2) describe present wood-using markets, marketing procedures and practices, and related marketing problems, and (3) recommend changes which should improve the wood-using markets for farmers and others with timber to sell.

FOREST MANAGEMENT

The Forest Management staff in the Columbus office carried forward a number of regional studies in the fields of forest regeneration, spoil-bank reclamation, silviculture, and mensuration. In addition, staff men served the branch stations in a consulting capacity, especially in developing research programs and in reviewing work plans, establishment reports, publication plans, and manuscripts.

Progress during the year, exclusive of that reported by the branch stations, and plans for 1950 are presented under the following headings: (1) regeneration, (2) spoil-bank reclamation, silviculture, and (3) mensuration.

REGENERATION

Progress and accomplishments in 1949

Some progress was made on a manuscript dealing with the effect of an old-field cover and protective overstories of sassafras, planted black locust, and planted pine on underplanted yellow-poplar, black cherry, ash, and red and white oaks.

Plans for 1950

The manuscript mentioned above will be prepared for publication.

SPOIL-BANK RECLAMATION

Progress and accomplishments in 1949

In addition to correlation of the reclamation research carried on by field units, and included in reports of the branch stations, the Columbus staff prepared a number of reports for publication and handled certain other phases of this regional project. A paper, Progress in Stripped Land Regeneration Research, was presented before the American Mining Congress, and published in the Coal Mine Modernization Year Book. Rehabilitation of Lands Stripped for Coal in Ohio was published as Station Technical Paper No. 113, in cooperation with the Ohio Reclamation Association. A brochure on The Reclamation of Strip-mined Lands by Forest Planting was also prepared during the year. With French and Spanish translations, this brochure was used in connection with the forest resources tour for delegates to the United Nations Scientific Conference on the Conservation and Utilization of Natural Resources.

The preparation of county strip-mine reconnaissance maps on an inch-to-the-mile scale was completed. Since 1948 maps of this kind have been prepared for all of the important strip-mining counties in Ohio,

Indiana, Illinois, Missouri, Kansas, and Oklahoma. These maps show the location and extent of lands stripped for coal by spoil type and coal seam. In some cases the coal outcrops are also shown. These maps have been in demand by local agencies and individuals responsible for reclamation of lands stripped for coal, and by other agencies.

A report, Overburden Analyses and Strip-mine Conditions in Northeastern Ohio, was completed and will be published early in 1950 as Station Technical Paper No. 114. It describes the composition of the various strata in the coal overburden. This composition has an important bearing on measures that can effectively be used for rehabilitating spoils resulting from coal-stripping operations.

Plans for 1950

In addition to preparation of Technical Paper 114, mentioned above, reports will be prepared summarizing overburden analyses and describing spoil conditions for seven other important strip-mining districts in Ohio.

The staff will continue to direct and integrate the reclamation research of the field units, with special emphasis on the maintenance of going studies and the preparation of publications summarizing data thus far obtained from these investigations.

SILVICULTURE

Progress and accomplishments in 1949

Plans were prepared for a publication showing the effect of several degress of pruning on the growth of planted pitch and shortleaf pines in southern Illinois.

Plans for 1950

The above-mentioned manuscript should be completed for publication.

MENSURATION

Progress and accomplishments in 1949

Publication of the results of the Illinois tree-volume study was delayed to permit form-class tests. These tests compared the Mesavage-Girard form-class volume with volumes of Illinois trees. The form-class tables were found to fit the trees with an average difference of only +0.43 percent for board feet, International 1/4-inch rule and +3.5 percent for cubic feet. The actual form class for each tree was known, and the cubic volume included only the sawlog portion of the tree. A

manuscript has been prepared covering this study. The manuscript contains correction factors by species for the Cumulative Volume Tally Sheets (Region 9, U. S. Forest Service, Milwaukee, Wisconsin), average form classes by species and diameter groups, cubic-foot volumes for pole-sized trees, and the ratio of bark thickness at breast height to that at the top of the first log.

Plans for 1950

The results of the Illinois tree-volume study will be published as a Station Technical Paper early in 1950.

FOREST UTILIZATION SERVICE

Progress and accomplishments in 1949

Foresters and agricultural economists generally agree that if the farm woods of the Central States are to be maintained in a productive condition, they must contribute a greater share of farm income. One basic factor in this situation is the common practice of selling stumpage rather than harvesting timber like any other farm crop. Discussions with farmers, farm foresters, and other interested and informed individuals, have established that lack of suitable equipment and knowledge is the most important reason why farmers do not do more of their own logging.

Considerable effort has been devoted to the discovery of equipment and methods that farmers can use in logging their woodlands. Tractor- and equipment-manufacturing companies have been approached to stimulate their interest in developing relatively inexpensive logging attachments to farm tractors and other farm equipment. Companies manufacturing tractors and auxiliary equipment are interested in a field study to test the suitability of their equipment for this use, and a working plan for such a study has been prepared.

In October a logging and sawmilling demonstration at Wooster, Ohio, was held in cooperation with the Ohio State University Agricultural Extension Service. More than 4,000 farm woodland owners, small sawmill operators, and other interested individuals saw the operation of the latest mechanized equipment suitable for use in the farm woods and at the small, portable sawmill. More than 40 equipment manufacturers were represented with equipment designed specifically for, or adaptable to, the needs of the farmer or other owner who desires to increase the returns from his woodland by doing his own logging.

In connection with the logging-equipment show, a panel discussion explored the use of portable chippers for the preparation of pulpwood and agricultural mulches and soil conditioners. Engineers representing the larger manufacturers of portable chippers participated in this panel discussion which focused attention on the need for specialized equipment and the possibilities of economic use of wood material that otherwise would be wasted.

The local FUS men organized the second gluing clinic conducted in the Central States by staff specialists from the Forest Products Laboratory. This clinic was attended by 32 plant managers and supervisors representing 21 factories producing glued-wood products having a retail value of 80 to 100 million dollars.

FUS men obtained in Kentucky preliminary information regarding the use of low-grade wood and sawdust as fuel in the production of dark-fired tobacco. This information served as the basis for developing a cooperative project between the Agricultural Experiment Station of the University of Tennessee and the Forest Products Laboratory. This project will seek to develop a more efficient and less hazardous wood burner

than the present practice of burning wood in trenches on the open-dirt floors of tobacco barns.

Specialists in animal feeding at the University of Illinois, the Ohio Agricultural Experiment Station, and at the University of Kentucky are studying the effectiveness of wood-sugar molasses and fodder yeast as supplemental livestock feeds. At the present time the principal source of molasses and yeast is the pilot plants at the Forest Products Laboratory and Wilson Dam of the Tennessee Valley Authority. Local FUS representatives have been instrumental in lining up animal husbandry specialists to conduct these feeding experiments.

To an increasing extent the Forest Products Laboratory looks to the local FUS units for guidance in formulating its research program. As a result of industry contacts of the local FUS men during the past year, eight specific projects have been included in the 1950 program of the Laboratory. The more important of these are: (1) yield of wood-sugar molasses and yeast from Central States species, (2) uses of modified woods (impreg, compreg, etc.) for specialty products, (3) suitability of woods and mill wastes of hardwood species for specialty pulp and paper products, (4) utilization of low-grade and defective hardwood species, including a broad study of hickory by the Laboratory and all eastern Forest Service experiment stations.

Selling research results is a major activity of the FUS unit. As a result of its widespread contacts with both primary and secondary industries, measurable improvements in wood-utilization processes have been noted both in specific plants and throughout industry. The larger secondary wood-processing plants have particularly benefited from the high priority given to moisture-control phases in the utilization of kiln-dried hardwoods. Exploratory work by FUS in potential markets backed up by small-kiln studies by the Laboratory encouraged the development of a small prefabricated dry kiln by a Kentucky manufacturer.

General consulting and advisory services to the wood-using industries and to other research institutions engaged in forest-products research occupied at least one-third of the time of the FUS men. Requests for assistance ranged from letters of inquiry on available markets for stumpage to "trouble-shooting" at major wood industries that sometimes involved on-the-ground assistance of Forest Products Laboratory specialists.

Plans for 1950

Liaison work between the Forest Products Laboratory and the wood-using industries will continue to be an important activity of the FUS unit. In this work special emphasis will be given toward the development of more efficient logging, milling, and processing equipment such as adaptations of farm tractors to better fit them for logging; the improvement of portable chippers; and the use of portable bolter saws in utilizing low-grade hardwood logs. In the field of remanufacturing,

special emphasis will be given to processes which hold promise of reducing processing waste, such as improved seasoning and moisture-control practices and practices that improve the utilization of wood waste through conversion to pulp and paper products, wood-sugar molasses, and other derived products.

FLOOD CONTROL SURVEYS

The scope of the Department of Agriculture flood-control survey program has been enlarged considerably during the past year. Responsibility for conducting the surveys still remains with the Forest Service and Soil Conservation Service; but the Extension Service and the Production and Marketing Administration will serve as consultant agencies in program development, and the Bureau of Agricultural Economics and the Solicitor's Office respectively will be consultants on the economic and legal phases of the proposed programs.

The increase in the number of agencies participating in the flood-control surveys should produce well-integrated and realistic remedial programs. The additional detail required for developing and determining the value of these programs should make the future survey reports more specific and should consequently facilitate considerably the initiation of action programs.

Progress and accomplishments in 1949

As in 1948, station flood-control survey activity during 1949 was restricted principally to participation in surveys under Soil Conservation Service responsibility. This participation involved (1) preliminary examinations and reports, (2) survey work outlines, (3) detailed surveys and reports, (4) review of reports, and (5) report revisions.

The work accomplished during the year, and the status on December 31, are summarized below:

Status and watershed	Watershed location
Preliminary Examination Completed	
Kentucky	Kentucky
Survey Work Outlines Completed	
Kentucky	Kentucky
Licking	Kentucky
Surveys Under Way	
Green	Kentucky, Tennessee
Kentucky-Licking	Kentucky
Upper Mississippi	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, South Dakota, Wisconsin
Surveys Completed	
Grand	Iowa, Missouri
Sangamon	Illinois
White (E. Fork)-Patoka	Indiana

Status and watershed (cont'd)	Watershed location
Survey Reports Reviewed	
Galena	Illinois, Wisconsin
Grand-Neosha	Arkansas, Kansas, Missouri, Oklahoma
Scioto	Ohio
White (E. Fork)-Patoka	Indiana
Reports Awaiting Revision	
Galena	Illinois, Wisconsin
Indian Creek	Iowa
Root	Minnesota
Scioto	Ohio
White (E. Fork)-Patoka	Indiana
Whitewater	Minnesota
Report Undergoing Revision	
Sny	Illinois
Reports Submitted to Congress	
Missouri River Basin Agricultural Program, 81st Congress, 1st Session, House Document No. 373.	Iowa, Missouri 1/

The comprehensive Missouri River Basin Agricultural Program, published as a House Document, includes the flood-control remedial program for this basin. To date the Congress has neither authorized nor appropriated any funds for undertaking this work.

Plans for 1950

It is expected that major consideration will be given to revising reports for submission to Congress. No additional surveys are planned for initiation until the backlog of reports awaiting revision has been reduced.

1/ Station activities confined to Station territory of responsibility for flood-control surveys.

BRANCH STATIONS

AMES BRANCH

Forest Management

Progress and accomplishments in 1949

Operations and "housekeeping chores" at the Paint Creek Experimental Forest continued to draw heavily on the staff of the Ames Branch. This experimental area, furnished by and operated cooperatively with the Iowa Conservation Commission, was undeveloped and unmanaged when it was set aside a few years ago for research purposes.

Management of oak-hickory stands.--During the year a study was started in oak-hickory stands to determine the optimum stocking for maximum production of high-quality products from this timber type in southeastern Iowa and comparable stands in northeastern Missouri. Plots were established in a 25-year-old stand and in a 50-year-old stand--both on state forest land in southeastern Iowa. If a suitable 100-year-old stand can be located, it will be included in the study.

Four treatments and a check, with four replications of each, have been established in the 25-year-old age class. The treatments reduced the original basal area by approximately 20, 30, 45, and 60 percent. The basal areas left per acre are approximately 60, 50, 40, and 30 square feet, respectively. In the 50-year-old stand, because of a limited area of this age class on the state forest lands, three treatments plus a check, with three replications of each, have been established. These treatments reduced the original stand by 30, 45, and 60 percent and left approximately 65, 50, and 35 square feet per acre, respectively. Field data relative to initial stocking have been secured for all plots. Cutting has been completed on about 75 percent of the plots, and some data on remaining basal area have been secured.

Aspen mortality study.--In the spring of 1948 a study was started at the Paint Creek Experimental Forest to obtain information on the economic and pathological rotation for bigtooth aspen (Populus grandidentata, Michaux). Small areas of this species in pure or practically pure stands are common in northeastern Iowa and the adjacent portions of Minnesota and Wisconsin. Seven 1/5-acre plots were established in stands about 50 and 80 years old. During the fall of 1949 the plots were reexamined to determine aspen mortality losses during two growing seasons. Although the information obtained in this resurvey may not be conclusive, it appears to be indicative of the mortality to expect of aspen at these ages.

In most of the plots aspen mortality was high (table 1). The heaviest mortality was in the two plots in the older age class where the competition of other species was greatest.

Table 1.--Two-year mortality of bigtooth aspen by basal area and number of trees

Plot		Living aspen trees		Basal area[1] spring 1948			Basal area[1] fall 1949	Aspen mortality	
Number	Age	Spring 1948	Fall 1949	Aspen	Other species	Total	(aspen only)	Basal area	Number trees
	Years	Number	Number	Sq. Ft.	Sq. Ft.	Sq. Ft.	Sq. Ft.	Percent	Percent
1	49	38	37	18.42	7.06	25.48	18.29	0.7	2.6
2	51	30	29	16.11	4.06	20.17	15.97	0.9	3.3
3	77	11	2	10.26	13.04	23.30	1.99	80.6	81.8
4	78	13	8	12.20	13.22	25.42	7.41	39.2	38.5
5	48	26	18	12.36	7.50	19.86	9.34	24.4	30.8
6	48	33	24	11.94	5.64	17.58	9.48	20.6	27.3
7	56	46	38	16.75	6.39	23.14	14.70	12.2	17.4

1/ Per plot of 1/5 acre.

Box bolt operation.--To utilize some of the mature bigtooth aspen on the Paint Creek Experimental Forest, a box bolt harvesting operation was carried out. A second objective was to determine the economic feasibility of such an operation. Ninety cords of bolts were sold to a fish-box manufacturing plant at Lansing, Iowa, for $12.00 per cord (3 x 4 x 8 feet) of 96 cubic feet delivered at the plant. The bolts were delivered to the plant by 2 1/2-ton truck. A round trip required 35 miles of travel. An average of 4.1 cords were hauled on each trip. On the basis of cost records it was found that a farmer or other operator could expect to earn about $10.00 per cord for his labor and the stumpage value of the aspen. Assuming a stumpage value of $1.75 per cord (96 cubic feet) for the trees, the income for labor was $8.25 per cord. The cost of equipment used in felling, bucking, skidding and delivering the bolts was about $2.00 per cord.

White pine plantation thinning study.--Additional work was done in the unmanaged eastern white pine plantation near South Amana in Iowa County, Iowa. Initial growth measurement studies, made in 1948, showed that this plantation, when 51 years old, contained an average of 295 trees of sawlog size and 130 pole-sized trees per acre. The average d.b.h. was 10.9 inches for all trees. The sawlog-sized trees averaged 11.7 inches d.b.h. with 34 feet of usable length. The per-acre gross volume was 6,976 cubic feet in all trees 4.6 inches and larger in diameter, and 33,467 board feet in stems 9.6 inches and larger. The average annual growth was 137 cubic feet and 656 board feet per acre. These studies indicate that the greatest diameter increment occurred when the trees were 22 to 31 years of age and that diameter growth steadily declined in subsequent decades. This implies overstocking and the need for thinning.

Arrangements were made with the Amana Society, owner of the plantation to establish thinning studies in the stand in 1949. The objectives of this study are to determine the possibility of (1) increasing the growth rate, (2) improving the quality of the stand and final products, and (3) increasing the financial returns. Four degrees of thinning were applied:

	Approximate reduction in basal area (Percent)	Basal area per acre after thinning (Sq. Ft.)
None (check)	0	250 (Approx.)
Light	20	200
Moderate	30	175
Heavy	40	150

Each treatment, including the check, was used on two 1/5-acre plots--making eight in all. An isolation strip, 0.35 chain wide, was left around each plot. The trees marked for removal are to be cut by the Society in the winter of 1949-50 and the volume cut determined.

Farm wood lot management.--A 72-acre farm-forestry tract has been established on the Paint Creek Experimental Forest. This tract will be operated in accordance with the best forestry practices that a farmer could be expected to apply to his farm woodland. The gross volume of the tract averages about 7,000 board feet or 2,223 cubic feet per acre. To obtain maximum growth, the desirable average volume of growing stock appears to be 4,000 to 4,500 board feet per acre. The stand will be reduced to this volume by removing about 1,000 board feet per acre in each of three cuts at 2-year intervals. After the desired stocking has been reached, future biennial cuts will remove only the equivalent of growth since the previous cut.

For the first cut 85,521 board feet gross volume has been marked for removal. This is an average of 1,187 board feet per acre. Detailed cost records and yield data are being kept on all phases of the operation. These will provide information for the farmers on the dollars-and-cents value of their wood lots.

The tract is divided into four compartments. On two of these the felling and bucking will be done, so far as possible, with a chain saw. On the other two, these operations will be done with 2-man crosscut saws. This will permit a comparison of costs for the two methods.

Species adaptability studies.--Two studies to determine adaptability of various coniferous tree species to soil and climatic conditions under some of the extremes found within the Branch province were planned and established in the spring of 1949.

On the Paint Creek Experimental Forest, in the very northeast corner of Iowa, 16 species of evergreens were planted in replicated plots of 80 trees each. The planting was done on a northeast exposure of

Fayette soil with slopes of 2 to 12 percent. The species planted were Austrian, eastern white, jack, lodgepole, pitch, ponderosa, Norway, tree Swiss, shortleaf, and Virginia pines; douglas-fir; eastern redcedar from two seed sources--Missouri and Nebraska; northern white-cedar; Norway and white spruces; and Rocky Mountain juniper. A count of living trees, made at the close of the first growing season, showed a survival of 91.4 percent for all species. Only three species had a survival of less than 90 percent.

The second study was started in western Iowa in cooperation with the Forestry Section of the Iowa Agricultural Experiment Station. This experimental planting is in the loessal hills of Monona County about 25 miles east of the Missouri River. It is on Ida soil that is highly calcareous, and the slopes range up to 35 percent. Nineteen species of conifers, including the species planted at Paint Creek plus Black Hills spruce, European larch, and Scotch pine, were used in this study. Three plots were planted, each of which contained 121 trees of each species. Unfortunately this planting was done under rather adverse conditions. The trees were planted during an unusually hot and windy period that was followed by 2 weeks without measurable rainfall. Furthermore, the planting was done by inexperienced planters. As a result, survival was not as good as expected. In the fall of 1949 it was 50.6 percent for all species. Only six species--eastern white, jack, pitch and lodgepole pine; Rocky Mountain juniper and white spruce--had a survival of over 70 percent.

It is recognized that some of the species, particularly those generally considered as suitable only for warmer climates, may not survive the rigors of Iowa's winters. Nevertheless it was decided to include them to prove whether or not they can be considered winter-hardy at either of the two locations.

Plans for 1950

Completion of the harvesting of the farm-forestry tract at the Paint Creek Experimental Forest will have top priority. A field day will be held to show the advantages of woodland management. It will be conducted in cooperation with the Iowa Extension Forester and State Conservation Commission.

Completing the establishment of the oak-hickory management study will also have high priority. This work should be finished prior to June 30.

A study to determine proper stocking, similar to the one discussed for the oak-hickory stands, will be established in the northern hardwood stands at the Paint Creek Experimental Forest if time permits.

The Paint Creek Experimental Forest will be divided into compartments preparatory to establishment of a series of management studies.

The study of species adaptability to site in western Iowa will be replanted with the same species used originally. The study plots at Paint Creek will be replanted and 12 new species added to the original planting on the northeast exposure. The complete study, 28 species, will be replicated on a southwest exposure adjacent to the 1949 planting.

The jack pine pruning study established in the spring of 1948 on state forest lands near Farmington, Iowa, will be remeasured to determine height growth and diameter growth since pruning. If growth warrants, the selected crop trees will be repruned to maintain the desired ratio of live crown area.

The aspen mortality study plots will be reexamined during the fall of 1950 to determine losses during the year.

The trees marked for removal in the Amana Society white pine plantation thinning study will be harvested. The volume cut will be determined and other data assembled.

Additional improvement cutting at the Paint Creek Experimental Forest will be undertaken if funds and time permit.

It is hoped that uncertainties relative to province boundaries and experimental areas will be settled during 1950 so that the problem analysis for the Ames Branch can be completed.

Forest Influences

Progress and accomplishments in 1949

Shelterbelts and blizzards.--Although research on shelterbelts in the Great Plains area is not included in the regular work program of the Ames Branch, the severe blizzards during the winter of 1948-49 afforded an excellent opportunity to study the benefits of the shelterbelts. Members of the Ames staff cooperated with the Soil Conservation Service in making a survey of the shelterbelts in Antelope and Holt Counties, Nebraska, during March, 1949. Snow-depth measurements of cross sections of drifts, moisture-content determinations, and various other data were collected during the survey.

By March 3 the drifts had settled approximately 2 feet, but many of the shelterbelts contained drifts 8 to 10 feet deep. Moisture content of the snow was high due to compaction and some earlier thawing. It was found that only 2.3 inches of snow was required to equal an inch of water. On this basis it was determined that most of the belts were holding in drifts the equivalent of 50 to 80 acre-feet of water in a mile-long planting.

The first drifting occurred about the middle of November, 1948, before the ground had frozen. In March, even after long periods of sub-zero weather no frost was found under drifts more than 15 to 18 inches

deep. Consequently, the water entered the soil as the drifts thawed slowly and increased the underground water supply, rather than running off the ground to add to the flood threat and damage in the spring of 1949.

The survey brought out the fact that the composition and density of shelterbelts are important because they affect the ability of tree plantings to stop winds and hold snow. Well-developed, dense plantations at least seven rows wide with a good conifer or shrub row on the windward side were the most effective in holding snow in or near the belt (fig. 1).

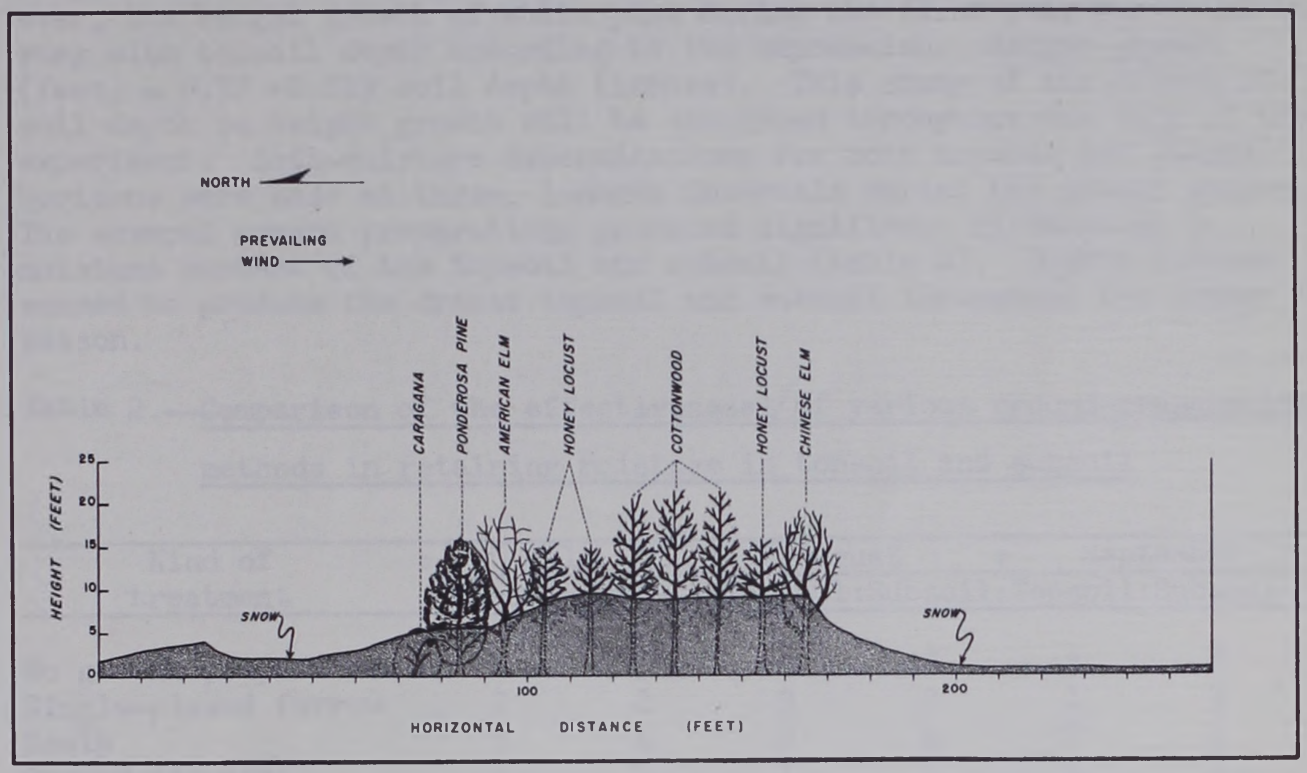
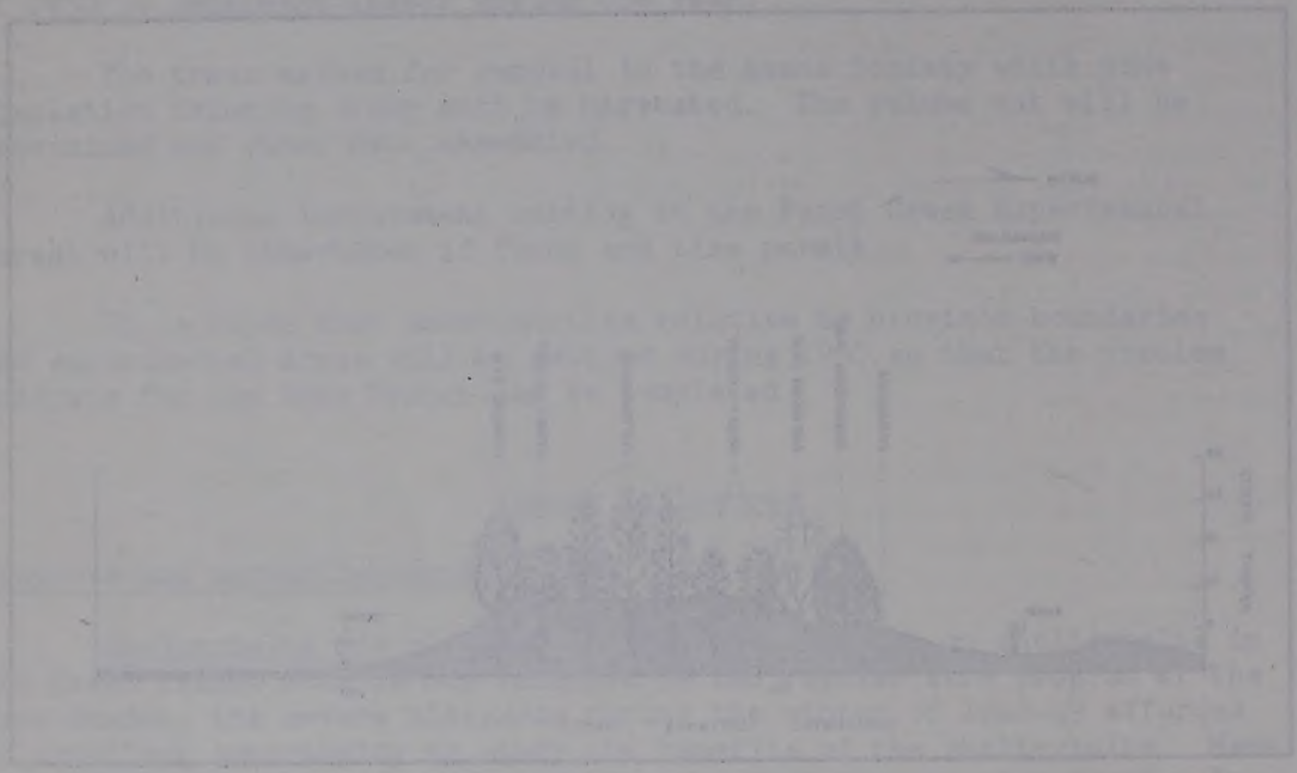


Figure 1.--Cross section of snow accumulation in a well-developed 10-row, 13-year-old shelterbelt having good shrub and conifer rows on the windward (north) side. Most of the snow is held within the belt.

Belts without a good shrub or conifer row on the windward side and those which were thin or open because of poor survival or wide spacing allowed much of the snow to drift through them. Narrower belts of five to seven rows with good shrub and conifer rows on the windward side, if otherwise sufficiently dense, were effective in stopping the snow, but most of the snow was on the lee side of the planted area. Even two rows of closely planted conifers were effective in stopping snow, but the bulk of the snow was deposited in a strip about 150 feet wide on the lee side of the belt.

Plans for 1950

No further research on shelterbelts in the Great Plains is contemplated during 1950.



Forest Management

Progress and accomplishments in 1949

Much of the research in forest management was limited to problems concerning the regeneration of abandoned agricultural land and land strip-mined for coal. A study was established in the spring of 1949 to determine the effectiveness of five methods of ground preparation on tree survival and height growth. Survival counts and growth measurements were taken at the end of the 1949 growing season. There were no significant responses to the various treatments at the end of the first year. However, the height growth of white pine during the first year was found to vary with topsoil depth according to the expression: Height growth (feet) = 0.72 +0.019 soil depth (inches). This study of the effect of soil depth on height growth will be continued throughout the life of the experiment. Soil-moisture determinations for both topsoil and subsoil horizons were made at three, 1-month intervals during the summer season. The several ground preparations produced significant differences in moisture content of the topsoil and subsoil (table 2). Double furrows seemed to produce the driest topsoil and subsoil throughout the summer season.

Table 2.--Comparison of the effectiveness[1/] of various ground-preparation methods in retaining moisture in topsoil and subsoil

Kind of treatment	July		August		September	
	Topsoil	Subsoil	Topsoil	Subsoil	Topsoil	Subsoil
No ground preparation	1	3	4	2	3	2
Single-plowed furrow	2	2	3	3	1	3
Scalp	3	4	2	4	2	4
Ground ripped[2/]	4	1	1	1	4	1
Double-plowed furrow	5	5	5	5	5	5

1/ Rank of 1 indicates the highest moisture content, and 5 the lowest.
2/ To a depth of 2 feet.

An investigation of the rate and quality of natural regeneration on old fields in southeastern Ohio was begun in the fall of 1949. This study was discontinued temporarily for a lack of funds, but it is expected that the field work will be completed in the spring or summer of 1950.

Soil fertility studies were initiated in 1949 as a supplement to many of the regeneration experiments established in the past few years on old fields as well as on spoil banks. At the start, relative amounts of essential elements occurring in the foliage of trees growing under certain conditions will be determined. Later the role of trace elements may be studied. In 1949, leaf collections were made from species growing

with black locust under various spoil-bank and aspect conditions. Leaf collections were also made from species grown under similar conditions but without the black locust. The analysis of these leaf samples should indicate the relative value of black locust in nitrifying the spoils on which it grows. Samples were also taken from trees growing on leveled and unleveled spoil banks to determine whether the leveling had an effect on the availability to trees of essential elements in the spoil materials.

A work plan and the initial establishment were completed for a direct seeding study designed to test methods of ground preparation for hardwoods and conifers. The seeding will be done in early spring of 1950.

Major effort in the field of spoil bank reclamation was devoted to the preparation of a report, Character and Extent of Land Stripped for Coal in Kentucky, in cooperation with the Kentucky Agricultural Experiment Station. This report was published as Kentucky Agricultural Experiment Station Circular No. 66.

A direct seeding study was initiated on the Wayne National Forest to test the survival and growth of seedlings on the two main types of spoil surface created by grading spoil banks. First observations will be made in the spring of 1950.

A black locust sprouting study was established on spoil banks to investigate the possibilities of coppice management. Winter and summer cuttings were made at two levels of intensity. First-year measurements of the sprouts were made in the fall. Although several years' observations will be needed before results of any practical value can be obtained from this study, the height differences due to season and intensity of cutting are significant (table 3).

Table 3.--Average height[1/] of black locust sprouts by age of original stand and by intensity and season of cutting

Age of original stand (Years)	50 percent of original stand cut		100 percent of original stand cut	
	Summer-cut	Winter-cut	Summer-cut	Winter-cut
	Feet			
4	4.7	8.0	6.4	8.9
14	4.8	7.5	6.2	8.7

1/ At end of first growing season.

The growth of white oak as related to soil and stand characteristics is currently under investigation. Fifty-one .2-acre plots were taken in 1949 and the plot data are being compiled and analyzed. The white oak study will also be supplemented by fertility investigations. Foliar analysis will reveal whether available nutrients and site index are correlated.

Two areas were tentatively selected for experimental forests and negotiations were initiated to have one or both of these areas set aside for this purpose. Several of the larger equipment items needed to conduct experimental logging have been purchased and are now on hand.

Plans for 1950

A replica of the ground preparation and methods of planting study established near Zanesville in 1948-49 will be planted near Cadiz, Ohio, in the spring of 1950. White pine only will be used. This replica will test the treatments and methods used in the original experiment under different soil conditions.

The direct seeding experiment for which the ground preparation was completed in 1949 will be seeded in the spring of 1950. Both hardwoods and conifers will be tested to discover the minimum ground preparation necessary to obtain acceptable establishment.

All planting and seeding experiments previously established on old fields and spoil banks will be maintained by taking the necessary survival counts and growth measurements scheduled for 1950. Some of the mixed plantings of black locust and other species are expected to be far enough advanced to show the effect of locust on the development of the associated species.

Negotiations for setting aside an experimental forest will be completed in 1950, and it is hoped that the boundary and compartment divisional lines can be located. Work will be started on the preparation of a management plan for the area as soon as it is definitely chosen.

Plans for 1950 call for completing the Branch Station program analysis that will outline the problems in the work area, establish priorities, and outline a long-range research program. An advisory committee will be selected to consider this program before it is put into effect.

Forest Influences

Progress and accomplishments in 1949

Forest influences research during the year has centered about the effect of forest stands and forest soils on the surface and subsurface movement of water. This research is reported under four subdivisions, as follows:

1. The accumulation and water-holding capacity of litter under the oak forest of southeastern Ohio.--The results of this study indicate that litter accumulation may not be influenced by stand age, frequency of trees reaching breast height or taller, basal area, or the proportion of white oak in the stand. However, the accumulation of

litter was significantly greater on gently sloping land than on steeper land according to the equation:

Litter in pounds per horizontal acre =
5900 - 40 (topographic slope in percent)

The use of the foregoing equation must be restricted to even-aged stands of oaks 30 years in age or older.

The capacity of oak litter to retain water against gravity is

Capacity in inches =
0.036 (litter weight in tons/acre) - 0.001

This capacity must be increased by some 18 percent to account for water held in puddles on the leaf surfaces.

With proper consideration for the frequency of litter-wetting precipitation, these equations can be combined to predict the total loss of water from the litter horizon itself. Thus, level uplands will lose 3.8 inches of water while 2.5 inches will be lost from a 50-percent slope if 30 litter-wetting rains occur during a year.

This study must be considered as a continuing project until an index of stand density superior to mere basal area is found. Research regarding the applicability of the tree-area ratio (percent of ground area covered by tree crowns) as a density index is presently being investigated.

2. Water-holding capacity of forest soil horizons.--This work is yet in the laboratory stage. Samples from 259 horizons have been collected, and laboratory determinations of mechanical composition, moisture equivalent, wilting percent, and organic-matter content are in progress. The water-holding capacity of soil gravel (2 mm to 25 mm diameter) at saturation is 10 percent of its oven-dry weight for sandstones and 12 percent for shales. Neither the total mass of soil gravel nor the distribution of particles by size classes within this range of diameters has any evident influence on water-holding capacity.

3. Infiltration and subsequent movement of water through forest soil horizons.--Some 280 measurements on infiltration rates under various cover conditions have been obtained. The final disposition of these data depends upon the completion of laboratory analysis indicated under item 2 above. The results of the infiltration study are being prepared for publication.

Approximately 480 individual measurements of soil permeability and apparent specific gravity have been obtained. These raw data await correlation with the laboratory measurements indicated in item 2 and forest stand conditions as measured in the field.

4. The growth and decay of root systems in forest stands.--Observations on the distribution of roots and root cavities were completed for 30 forest stands. This study was implemented by the excavation of pits 3 to 7 feet in depth and 12 feet in length. The pit face was used to determine the frequency and size of living roots by soil horizons. This study is designed to show the macroscopic effect of tree-root penetration on soil characteristics, especially on soil permeability. Upon completion of laboratory measurements of the permeability of soils lacking in root cavities, this study will be ready for final analysis. These data will be made available for special studies in allied fields of forest research.

Plans for 1950

The progress of the current year has been largely confined to the collection of facts in the field and laboratory. In the coming year these data will be assembled and analyzed in the hope that they will provide information on the relationship of forest stands and forest soils to the movement and storage of water.

Forest Management

Progress and accomplishments in 1949

A series of six cutting-practice demonstrations on the Kaskaskia Experimental Forest was completed during 1949. Three of these areas, averaging 5 acres each, are in the mixed hardwood type and the other three, averaging 1½ acres each, are in the oak-hickory type. One area in each forest type was marked and treated according to presently known good forest practices. In these two good-practice areas all large, mature, or over-mature trees were harvested, and a heavy improvement cut was made in all diameter classes. The residual trees are the best of the original stand. In the mixed hardwood type this treatment removed 53 percent of the board-foot volume and 40 percent of the basal area, and left 2,030 board feet of saw timber and 47.5 square feet of basal area per acre (table 4).

Table 4.--Saw-timber volume and basal area per acre before and after cutting-practice treatments

Forest type and cutting practice	Saw-timber volume[1]			Basal area[2]		
	Original stand	Volume removed	Residual stand	Original stand	Basal area removed	Residual stand
	Bd. ft.	Percent	Bd. ft.	Sq. ft.	Percent	Sq. ft.
Mixed hardwood						
Good practice	4347	53	2030	79.4	40	47.5
Reasonable practice	5417	77	1257	102.7	37	64.2
Poor practice	3342	100	0	59.6	88	6.9
Oak-hickory						
Good practice	2673	53	1244	68.4	33	45.6
Reasonable practice	1975	68	635	56.0	27	40.9
Poor practice	3368	100	0	63.2	72	17.4

1/ Volume by International 1/4-inch rule of all trees more than 10.5 inches in diameter at breast height.
2/ Includes all trees more than 4.5 inches in diameter at breast height.

A second area in each type was marked and treated according to reasonable forest practices (following the Minimum Cutting Practice Rules, Forest Service, Region 9). The rules were not intended to provide a high level of practice but rather to define minimum standards which will maintain the forest land in a reasonably productive condition. They require that 15 saw-timber trees per acre be left in the mixed hardwood type and that 10 saw-timber trees per acre be left in the oak-hickory type. Also, a specified number of pole trees and all seedling and saplings are to be

left. No intensive improvement treatments were made in the residual stands. This treatment removed 77 percent of the saw-timber volume and 37 percent of the basal area in the mixed hardwood stand.

On the third area in each type, all merchantable trees down to about 4.5 inches d.b.h. were cut, and no improvement treatments were made. This practice removed all the saw-timber volume and 88 percent of the basal area in the mixed hardwood stand. This series of "show-window" demonstrations should illustrate the effect of the three treatments on stands of the two forest types.

A tract of about 24 acres of good upland hardwood timber has been selected on the Kaskaskia Experimental Forest to demonstrate the money-making aspects of a small but well-managed woodland. An additional stand, equal in size but in a badly depleted condition, was also set aside to demonstrate the methods needed and the net cost of rebuilding a badly deteriorated farm woodland to the point where it begins to provide a dependable income.

The good woodland was divided into three 8-acre blocks. Slightly less than the annual growth of the entire tract will be cut from one of the blocks each year, and the stand will be improved gradually through harvest and intensive improvement treatments. Records of the products harvested, and of the costs of treatments and returns from the sale of products will be maintained. The first 8-acre block was cut and improvement treatments were made during the past year. The following products were harvested:

Number of saw-timber trees cut: 17
Number of sawlogs obtained: 39
Net volume, International 1/4-inch scale: 4730 bd. ft.
Volume of bourbon stave bolts: 26.5 chord feet; 265 bd. ft.
Total net volume harvested: 4995 bd. ft.

The cutting and harvesting phases of a comprehensive management study on the Kaskaskia Experimental Forest were also initiated last year. Eighteen compartments averaging about 20 acres each had previously been established in the mixed hardwood type and an equal number in the oak-hickory type. The costs and returns from several different systems of forest management will be tested on the compartments. The comparisons in these tests will be between even-aged and uneven-aged management, long rotations and short rotations, long cutting cycles and short cycles, intensive and extensive management, and between combinations of these variables. During the year, harvest cuts were completed and the intensive management treatments initiated on 10 compartments covering 169 acres.

A stocking study in even-aged nearly pure pin oak was established on the Shawnee National Forest and the initial treatment made during the year. A combined improvement cut and thinning of three intensities left residual stands of about 95, 80, and 65 square feet of basal area. Similar treatments will be made at approximately 5-year intervals to maintain

desirable basal areas and will be continued until the stands are clear-cut for piling and saw timber.

A commercial thinning of a 13-year-old loblolly pine plantation on claypan soils common to southern Illinois produced 319 pit props and 183 fence posts per acre with a total stumpage value of about $30. Before thinning the stand consisted of 572 merchantable trees per acre. By utilizing their stems to a 3.5-inch top, these trees could have been converted to 722 mine props and 411 posts, or to 1133 posts per acre. Projection of the past growth rate of the plantation indicates that within 4 or 5 years the thinned portion of the plantation will grow from a present basal area of 81 square feet to about 125 square feet per acre. This growth will be placed on the straight, clean trees and will yield approximately 6 cords, or 250 mine props, or 400 posts per acre.

A study designed to determine the size of openings needed to convert poor-site oak-hickory forests to a mixture of oak and conifers was initiated last year. First-year results showed good success for shortleaf pine planted in all sizes of holes cut in the stand canopy. Pines planted under the adjacent canopy had much poorer survival and growth (table 5). The diameter of opening did not seem to have a significant effect upon the first-year survival or growth of the pine.

Table 5.--First-year survival and height of pine planted in openings and under adjacent crown canopy

Diameter of opening 1/	Survival		Height	
	In openings	Under canopy	In openings	Under canopy
	Percent	Percent	Feet	Feet
1/2 stand height	88.9	65.7	0.60	0.50
1 stand height	83.5	62.6	.65	.51
2 stand heights	80.0	59.7	.67	.51

1/ Diameters of the openings cut in the stand canopy were one-half, equal to, and twice the height of the dominant trees, which were 50 to 65 feet tall.

As a part of this stand-conversion research a 16-acre oak-hickory compartment was clear-cut and planted to shortleaf pine last spring. Sample survival counts made in December 1949 showed that there were 790 living pines per acre and that first-year survival was 75 percent. Sixty percent of the pine-stocked sample milacres also contained voluntary oak and hickory. The pines were mostly vigorous, ranged in height from about 8 to 20 inches, and did not require releasing at the end of the first year.

Plans for 1950

During the next year a harvest and improvement cut will be made on the second 8-acre block of the good farm woodland. The first phase of rehabilitating the poor farm woodland will also be completed. This will consist of a heavy improvement treatment, harvest of the mature trees, and spot-planting where necessary in openings or poorly stocked areas. An additional 12 to 15 compartments in the comprehensive forest management study will be treated in 1950.

Results of the stand objectives study will be condensed and prepared for publication.

Within the next 12 to 18 months, plans will be developed and locations selected for four long-time forest management investigations. These will be conducted in the uplands of southern Illinois and are as follows:

1. A study to determine optimum stocking of hardwood stands by major forest types and sites.

2. A study of the response of poles and small saw timber to releases afforded by harvest cuttings in uneven-aged management.

3. A study of the establishment and subsequent development of natural hardwood reproduction following cutting under the different systems used in the comprehensive forest management investigation on the Kaskaskia Experimental Forest.

4. A study of pine plantation management, including the variables of age, species, and site.

Regeneration

Progress and accomplishments in 1949

A problem analysis covering the reforestation of essentially open land, reinforcement planting of partially stocked stands, and plantation management was completed during 1949. It gives a basis for regeneration and plantation-management research in the branch station province and defines the studies needed to solve the problems in these fields. The analysis was reproduced for limited distribution.

Survival and height measurements were taken this year on 3-year-old plantings established to demonstrate the adaptation of seven species to two common old-field planting sites. The results show that, for the two sites, survival and height vary among species and between sites (table 6). Loblolly and shortleaf pine made the best growth on both the

medium and poor old-field sites. However, the hardwoods grew better on the medium sites than on the poor sites.

Table 6.--Average third-year height and survival, by species and sites for species-adaptation demonstrations

Species planted	Poor site		Medium site	
	Survival	Height	Survival	Height
	Percent	Feet	Percent	Feet
Loblolly pine	90	3.5	91	4.3
Shortleaf pine	92	2.6	92	3.2
White pine	93	2.1	89	2.6
Redcedar	91	1.1	95	1.7
Yellow-poplar	92	1.1	91	2.1
White ash	91	1.5	98	1.9
Black walnut	60	0.9	75	1.4

The development and use of successful fall-planting methods would approximately double the duration of the yearly planting season, reduce the spring work load, and shorten the reforestation job. Since they were first abandoned, many of the upland old fields of southern Illinois have gone through an ecological succession, accompanied by an increasingly heavy vegetative cover. The heavier cover reduces frost heaving and thus offers hope for successful fall planting on many old-field sites.

Current studies of fall planting, using several planting methods on several upland sites, have strongly indicated that fall planting can be successful if no scalp is used and if the cover type is broomsedge or broomsedge mixed with briars and brush. Frost heaving was found to be unimportant on plots with broomsedge cover, and also on plots planted without scalping (table 7).

Table 7.--The effect of cover type and scalping on frost heaving of fall-planted shortleaf pine

Vegetative cover	Trees frost heaved	
	Planting spot scalped	Not scalped
	Percent	Percent
Annual weeds and grasses	54	10
Broomsedge or sedge and briars	13	4
Mixed broomsedge and brush	15	5

Two of the hand methods found to be most promising in the fall-planting study were further tested on a pilot-plant basis in a field having moderately heavy cover of mixed broomsedge and annuals. In

addition, the Lowther tree planter was similarly tested. These plantings showed that trees can be satisfactorily planted in the fall in broomsedge or in broomsedge and brush cover and that the slit method without scalp is both the cheapest and the best (table 8). Fall planting with the Lowther machine gave low survival chiefly because of excessive frost heaving during the first winter.

Table 8.--First-year survival and planting costs for fall-planted shortleaf pine

Planting method	First-year survival	Trees frost heaved[1/]	Live trees obtained per man-hour of planting time[2/]	Labor cost per 1000 live trees
	Percent	Percent	Number	Dollars
Mattock, slit without scalp	76	6	84	8.93
Mattock side-hole with 6-inch scalp	69	38	45	16.65
Lowther tree planting machine	45	51	-	-

1/ Frost heaving actually killed only a part of the affected trees.
2/ Planting crews were able to plant 110 trees per man-hour by the mattock-slit method and 65 trees per man-hour by the mattock side-hole method with 6-inch scalp. Labor was charged at the rate of 75 cents per hour.

Direct seeding has a proper place in a reforestation program when it can be done with reasonable success and when the cost is considerably lower than planting nursery stock. Experiments in the southern Illinois uplands and in the southeastern states indicate that hand seeding of pine is neither successful enough nor cheap enough to compete with planted seedlings. However, a machine seeding method found successful in the southeastern states shows real promise as a reforestation technique on some vegetative cover types in southern Illinois. In using this method shallow furrows are plowed on the contour 6 to 8 feet apart at least 2 months prior to seeding. Pine seeds are sown in the furrows with a push-type Planet, Jr. mechanical seeder at the rate of three or four seeds per linear foot of furrow. Sowing may be done in the fall or early spring, but fall plowing and early spring seeding are probably better.

Machine seeding was tested on 11 different experimental areas in the southern Illinois uplands. The results (table 9) are based upon observations made in June of the second growing season after seeding. Machine seeding was not successful on cover types in the early vegetative stages--that is, annual weeds and grasses--but showed definite promise for areas having more advanced cover types.

Table 9.--Number of seedlings[1/] from machine-seeded pine by cover type and time of sowing

Species and time of sowing	Broomsedge plus: light brush	Mixed broomsedge and annual weeds and grasses	Annual weeds and grasses
	Number		
Shortleaf pine March 1948	1.2	1.1	0.0
Shortleaf pine December 1947	1.0	.6	.1
Loblolly pine December 1947	1.2	.9	.3

1/ Average number of seedlings per 8-foot section of furrow that were living in June of the second growing season after planting.

Southern Illinois has no native pine forests but, because the old-field planting sites are badly depleted, pines are widely used in the present reforestation program. This makes particularly important the determination of seed sources best adapted to the climate and soils of the area. Seed was collected from six geographic sources of shortleaf and of loblolly pine. In cooperation with the Illinois Division of Forestry the shortleaf pine seed was planted in a single nursery bed in the Union County State Nursery. Loblolly pine seed from all sources was planted in an adjacent nursery bed. In the spring of 1949 the 1-year-old seedlings were planted in experimental plots on upland and claypan old fields of southern Illinois.

The mean survival of all trees planted in the upland plots was 95 percent at the end of the first season in the field. There were no significant differences in survival between trees from the various sources. However, at the end of the first growing season following planting in the field, the average heights of trees from different seed sources varied significantly (table 10). The measured heights included growth in the nursery plus growth during the first year after field planting. Because of variations in seed germination and fortuitous differences in density of sowing, seedlings from some seed sources had a lower nursery-bed density than others. In some cases low seedling density could have contributed to more vigorous growth of seedlings, but in other cases high seed-bed density was associated with high growth vigor. Although not measured, differences in seedling height and foliage color, presumably due to seed source, were apparent in the nursery.

Table 10.--Mean height of planted trees from seed of various sources and the statistical significance of height differences

Seed source[1]	Mean height[2]	Statistical significance
	Feet	
Shortleaf Pine		
Arkansas	1.14	Each of the three groups of mean tree heights is significantly different from all other groups at 1 percent level (probability is less than 1 in 100 that differences are due to chance). There are no significant differences between tree height means within groups.
Mississippi	1.12	
Oklahoma	1.00	
Kentucky	0.96	
Missouri	0.94	
Ozark National Forest		
Loblolly Pine		
South Carolina	1.30	Each of the three groups of mean tree heights is significantly different from all other groups at 1 percent level with the exception that Mississippi and North Carolina sources are significant at the 5 percent level (probability is not over 5 in 100 that differences are due to chance). There are no significant differences between tree height means within groups.
Mississippi	1.24	
North Carolina	1.17	
Maryland	1.13	
Virginia	1.10	
Arkansas	0.98	

1/ In most cases the source is known to the county or section of state. It is still too early to attach practical importance to the different sources as seed suppliers for southern Illinois and adjacent regions.

2/ In every case mean height is based upon five plots, each of which contained 216 planted trees. Measurements were made at end of first growing season following planting in the field.

Test plantings of two pine hybrids, in comparison with pure loblolly pine, were started in southern Illinois last year. Hybrid seed of two loblolly and shortleaf pine crosses was supplied by the California Forest and Range Experiment Station. Pure loblolly pine seed was collected in Polk County, Tennessee. All seed was planted in the same nursery bed at the Union County State Nursery. The 1-0 seedlings obtained were planted during the spring of 1949 in experimental plots located in upland old-field sites. Because of very low density in the nursery bed due to poor germination, the pure loblolly seedlings were as large or larger than the hybrid stock at time of field planting. At the end of the first season in the field, hybrid H_2 was significantly taller than either hybrid H_1 or pure loblolly pine (table 11). Pure loblolly was significantly taller than H_1.

Table 11.--Average first-year height[1] and survival of two hybrid pines and pure loblolly pine

Plot number	Hybrid H_1[2]	Hybrid H_2[3]	Loblolly pine
	Feet		
1	1.4	2.0	1.8
2	1.3	1.9	1.5
3	1.4	1.9	1.6
4	1.5	1.6	1.5
5	1.4	2.0	1.9
6	1.5	2.2	2.0
Average height	1.4	1.9	1.7
	Percent		
Average survival	98	99	100

1/ Total height at the end of 2 years from seed; 1 year in the nursery bed and 1 year in the field plots.
2/ H_1 - Shortleaf pine x loblolly pine, open pollinated and interpollinated.
3/ H_2 - (Shortleaf x loblolly) x loblolly, and loblolly x (shortleaf x loblolly).

Plans for 1950

Additional pilot plant studies of machine seeding of pine and of fall planting methods will be established. A redcedar seed source study, similar to the one established for pines, will be initiated. Cedar stock from eight sources is now being grown for this study in the Illinois State Nursery at Havana, Illinois. A survey will be made of newly acquired open lands on the Kaskaskia Experimental Forest and plans developed for a study of species adaptation to site.

Going studies will be continued and the results, as they become available, will be summarized for publication.

Spoil-Bank Reclamation

Progress and accomplishments in 1949

During the year two new studies were established in Indiana to obtain more evidence on the effects of black locust on the growth and development of associated hardwoods growing on spoil banks. Otherwise, work in this field consisted mainly of maintaining previously established studies in Illinois and Indiana, and of summarizing data and preparing a report on the extent, character, and forestation possibilities of land stripped for coal in Illinois.

Plans for 1950

Priority will be given to completing and publishing a report on spoil-bank reclamation in Illinois. In addition, new black locust-mixed hardwood planting tests on various spoil conditions will be initiated in Illinois during 1950.

NORTHERN OZARK BRANCH

Forest Management

Progress and accomplishments in 1949

During 1949 the Northern Ozark Branch continued old studies on the conversion of low-quality oak stands to oak-pine stands, gathered stand data on proposed experimental areas preparatory to establishing optimum stocking studies, progressed on the development of the Sinkin Experimental Forest, continued research on spoil-bank reclamation, and started work on improving the quality of black walnut through mixed planting and pruning.

Conversion of low-quality oak stands to oak-pine stands.--Field plots for old studies concerned with improving the species composition of low-quality oak stands were examined and remeasured early in 1949. These studies, initiated as a part of the Civilian Conservation Corps program, have provided much useful information on the problems of eliminating undesirable trees and increasing the stocking of shortleaf pine. Although the data obtained from the last remeasurements have not been analyzed, it is more than ever evident that neither natural nor planted pine will do well under a hardwood overstory. For best development, the pine should be given as complete an overhead release as is consistent with the wise use of the hardwoods. Furthermore, the release should be made at the time of planting or as soon thereafter as possible. It is recommended that the harvest cutting, girdling of cull hardwood trees, and planting or seeding of shortleaf pine be considered one operation, to be completed within as short a period of time as possible.

Experimental forest development.--Detailed administrative maps, compiled from aerial photographic mosiacs and printed with fitted topographic overlays, were prepared for the Bunker and Cedar Bluff units of the proposed Sinkin Experimental Forest. The boundary lines and internal section lines of the Bunker Unit were resurveyed and re-established on the ground. Additional data on forest-cover types and stand-condition classes of the forests on the area were assembled preparatory to the formal withdrawal of the area as an Experimental Forest.

Spoil-bank reclamation.--The first draft of a manuscript on the extent, location, character, and present use of strip-mined land in the Western Interior Coal Province (portions of Missouri, Kansas, Oklahoma, Iowa, and Arkansas) was completed late in 1949. This manuscript is based on the data collected in a region-wide reconnaissance of land strip-mined for coal. When completed it will represent the best information available on the spoil banks in this area and will provide a sound basis for future work in restoring these lands to production.

The plantations established on spoil banks in the Western Interior Coal Province to test the adaptability of several forest tree species to spoil-bank conditions were examined and remeasured last fall. Of the species tested, black locust, black walnut, bur oak, green ash, sycamore, and eastern redcedar showed considerable promise for use in rehabilitating land strip-mined for coal in this area.

The survival and early growth of black locust were extremely good and better than for any other species. The continued rapid growth of locust on spoil banks in other areas is evidence that locust will reach post size at an early age. However, until more information is available on the extent to which locust stands will be infested with locust borer, the value of locust as a direct source of a cash income is questionable. Because of the early cover provided and the nitrogen added to the soil by locust, it has the indirect and dependable value of being a very good nurse crop for other higher-value and more dependable hardwoods, good stands of which are more difficult to establish on spoil banks.

Black walnut planting study.--Black walnut is a high-value species. Although it constitutes only a small proportion of the total timber crop in this region, it supplies a large part of the walnut used in the United States. Because of its high potential value, many individuals and organizations are showing increased interest in planting walnut on spoil banks and other lands.

Good stands of walnut are difficult to establish. Walnut seedlings are difficult to transplant because of their large tap root. Walnut seed is relatively inexpensive and easy to plant, but poor germination, rodent damage, and early mortality often result in understocked stands. Furthermore, walnut trees grown in pure stands or in understocked stands are usually lower in quality than those grown in mixture with other species in relatively dense, natural stands. Apparently black walnut is benefited by planting in mixtures with locust and other species. It seems desirable therefore to determine the species mixtures that favor the development of high-quality black walnut trees.

During 1949, plans were made to cooperate with the Pittsburg and Midway Coal Company of Pittsburg, Kansas in a study to test the effects of black locust and four other species on the growth and quality of interplanted black walnut on spoil banks. Since it will be necessary to continue the study over a long period of time, each mixture of species will be planted on a sufficiently large area to provide an adequate sample of trees when they reach merchantable size. The planting areas, totaling approximately 23 acres, have been selected, and the general design of the study has been approved.

Black walnut pruning study.--A detailed work plan was completed for a study to test the effect of removing different proportions of the live crowns of various-sized walnut trees on subsequent height and diameter growth, on the development of sprouts on the pruned portion of

the bole, and on the quality of wood produced. Provisions were also made to study decay incidence in pruning wounds, wound healing, origin and location of sprouts, and time required for pruning.

The area on which this study is to be made is typical of the 2,000 acres of 13- to 16-year-old black walnut plantations established by the Civilian Conservation Corps on spoil banks in southeastern Kansas. The present stocking of most of these plantations ranges from 300 to 600 trees per acre. The dominant and codominant trees have made very good growth and average approximately 4 inches in diameter (d.b.h.) and 20 feet in height. In the denser portions of planted walnut stands, the crowns are starting to close. Although some of the lower branches are already dead, they are likely to persist for many years. The wood formed on these trees will not be top quality as long as these branches and stubs remain on the bole.

It is generally agreed that the quality of the wood produced on such trees can be improved by removing the dead branches. This study will provide information on the feasibility of obtaining greater clear length of bole by removing some of the lower live branches when the dead branches are removed.

Plans for 1950

The 720 trees involved in the walnut pruning study will be pruned in January and February according to the procedure set up in the work plan. Other than general observations which may be made when in the vicinity, no further work is scheduled for this study in 1950.

A detailed work plan will be completed for a study to test the effects of locust and other species on the growth and quality of interplanted black walnut on spoil banks. The planting will be done in March and first-year observations will be made the following fall.

Work will be started on studies of the growth, quality, and products obtainable from stands varying in stocking and proportion of pine and hardwood trees when managed on short and long rotations. Work during 1950 will be concentrated in stands with high proportions of pine. If started now, these studies should yield much information on desirable stand density and composition by the time commercial thinnings are possible in the several million acres of young sapling and pole stands in the pine-hardwood areas. The major part of the work will be done on the experimental forests, but other stands on the national forests will be used to provide tests on a wider range of age classes and site conditions.

An effort will be made to assemble the necessary descriptive information on the Bunker and Cedar Bluff units of the proposed Sinkin Experimental Forest so that they can be formally withdrawn as Experimental Forests in 1950.

Efforts will be made to complete and publish as Station Technical Papers, reports entitled, The Strip-mined Lands of the Western Interior Coal Province and Some Factors Affecting the Sprouting of Blackjack Oak. If at all possible a start will be made on the preparation of a report on the possibilities of direct seeding as a means of increasing the stocking of shortleaf pine.

An over-all problem analysis and tentative research work program for the Ozarks and similar adjacent areas will be prepared and presented for consideration by the Advisory Committee at a meeting tentatively scheduled for late next spring. After the problem analysis has been reviewed by this committee and others, it will be revised in the light of suggestions received and will thus provide the basis for drawing up a short- and long-time research program for the area.

Forest Range Management

Progress and accomplishments in 1949

Efforts in range research during 1949 were devoted almost entirely to collecting and analyzing information for a range problem analysis and research program for the Ozarks. Special attention was given to a field study of the vegetation, present use, soil, topography, and other features of the Ozark area. Numerous on-the-ground discussions of the Ozark range situation were held with livestock owners and personnel of the U. S. Forest Service (including the Division of Range Research, Washington, D.C., National Forest Administration, and the Southern Forest Experiment Station), the University of Missouri, the Soil Conservation Service, The Missouri Conservation Commission, and the Wildlife Research Unit. Detailed examinations were made on a number of reseeding areas, livestock and deer exclosures, burned-over sites, timber-sale and timber-stand-improvement tracts, and remnants of various cover types. Records of herbage yield were obtained from several improved pastures established on old fields by National Forest Administration, and assistance was given in the planning of additional seedings. Various methods and devices were tested for measuring range vegetation in the Ozarks, and several types of exclosures were checked for their practicability in determining the herbage production of grazed pastures. The principal forest and range conditions that bear on a range research program for the Ozarks are discussed in the following paragraphs.

Judging from early writings, the character of the Ozark forest cover has changed from one consisting mainly of large, rather widely spaced trees with comparatively little tree reproduction and a more abundant grass cover to a forest made up of younger, more closely spaced trees with scarcely any grass under them. It is generally believed that before the Ozarks were settled, tree reproduction was kept down by the combined effects of recurrent fires and the competition of mature trees and perennial grasses. Also, persistent browsing by a heavy deer population undoubtedly retarded the growth of small trees. As settlers came

into the country, most of the merchantable trees were cut and cattle were brought in in such numbers that the grass cover was greatly reduced. Browsing was eliminated by killing off the deer. Thus released from competition the tree reproduction increased in number and growth rate. The practice of frequent burning in an effort to prevent trees from crowding out the forage succeeded only in keeping the tree reproduction from reaching merchantable size. Furthermore, fire favored those herbaceous species which were able to withstand both fire and overgrazing. Generally the grass species left were those that "fire didn't kill and cattle wouldn't eat."

The policy of National Forest Administration is to make the best use of existing forest range forage and to encourage the development of grazing resources outside the forested area. Carrying capacities are based primarily on the nonforested range and open woodlands that are easily accessible to livestock. Wooded range is given little or no carrying capacity but is held for emergency use during periods when forage elsewhere is scarce. Free use permits, issued on a family basis, are limited to five cattle or horses and three sows with current litters. Livestock in excess of these numbers is grazed under paid permit. The grazing season of 7 or 8 months usually opens May 1 and closes November 30 or December 31. Resident livestock owners are given preference over nonresident owners. Neither sheep nor goats are permitted on national forest range. Preference in granting grazing permits is given to resident stockmen who have ample forage resources off the forest to care for their livestock during the 4- or 5-month period when it is not on national forest range.

Although forest range types are not so distinct in the Ozarks as in the West, four situations deserve separate consideration.. In some cases all four types occur on a single forty, but more often one or two types will dominate an ownership and thus decide the best use of the land unit. The four situations are: (1) good to fair timber stands, (2) poor timber stands, (3) old fields, and (4) glades. The relative merits of each of these types for grazing are briefly summarized in the following paragraphs.

Good to fair timber stands.--According to Forest Survey data only 23 percent of the forest land in the Missouri Ozarks is producing 2- and 3-log hardwood trees. Fair timber sites, those that are producing 1- and 1½-log trees, occupy 69 percent of the forest land. The green weight of herbage from both grasses and legumes in well-stocked stands seldom exceeds 200 pounds per acre, and the estimated carrying capacity of such woods range for an 8-month period is from 40 to 60 acres per cow. Since opportunities for a continued and expanding range-livestock industry in the fair and good timber stands are very limited, and since marketable timber can be produced on these areas without encouraging erosion, they should be kept in timber except where stocking is low and where the need for forage is high. Thus, the need for range research is not as great on good timber stands as on the other range types.

Poor timber stands.--Eight percent of the forest land in the Ozarks is producing timber with an average merchantable length of only one-half log. Thus there are probably over 800,000 acres of poor or short timber in the Ozarks. The carrying capacity of well-stocked portions of the poor forest stands probably does not average more than 1 cow per 40 to 60 acres for an 8-month grazing period. Understocked timber stands which comprise from 6 to 14 percent of all forest stands in the Ozarks produce considerably more herbage than fully stocked forests and will support a cow for 8 months on from 10 to 30 acres. The need for range research from the soil conservation standpoint is not urgent on well-stocked forest stands, because the tree cover effectively protects the soil. It may not be economically feasible to convert well-stocked stands to forage production. However, the possibility of eliminating trees on poorly stocked stands should be investigated where the economic needs of forest residents for forage are acute. Except for sprout-control studies, poor timber stands should have relatively low priority in establishing a range research program.

Old fields.--Throughout the Ozark forest range area many small, abandoned old fields are found. Most of these are on or near ridge tops, are surrounded by woods, and are idle because the soil, after a few season's use, became too poor to produce paying crops. Without improvement, old fields have grazing capacities (8-month basis) of 8 to 15 acres per cow. Relatively good tame pastures can be developed on these fields at costs ranging from $30 to $50 per acre for fertilizer, lime, seed, and tillage. One to three acres of these improved fields will support one cow for 8 months. The forage produced on old fields will become increasingly important as the surrounding timber stands become more completely stocked and as forage yields become progressively lower. Old fields should be given attention in the range research program. However, since the area is relatively small, and since considerable progress has been made in developing procedures for improving tame pasture and in developing seed mixtures, old fields should be assigned intermediate priority.

"Glades."--The glades are probably the only extensive, permanent natural grassland areas in the Ozarks. Estimates place the total acreage of the glades at about 500,000 acres, most of which is found in the White River country in the southwestern Ozarks. Glade ranges in good condition produce about a ton of green herbage per acre and will support a cow per 10 acres for an 8-month season. Glade range is more suitable for use by cattle than for other classes of livestock. It is believed that the open glades will continue to be used primarily for cattle grazing for many years to come. Since they cannot be cultivated and they will not produce good timber, wild grass will continue to be their primary crop. The glades should be placed first in priority in the grazing research program because they are the most productive and most permanent grazing lands in the Ozarks.

Plans for 1950

Plans for range research as worked out at a field program conference October 3-7 include: (1) completion of the range research problem analysis, (2) initiation of preliminary studies on chemical control of woody plants, and (3) if time permits, the preparation of a tentative work plan for a forage study to be conducted in 1951 in order that some of the techniques can be tested during the 1950 field season. Another activity which may demand some attention is the development of working plans for reseeding research in connection with the national forest range reseeding program. Emphasis will be placed on the completion of the program analysis and on the initiation of a study on chemical control of woody plants.

COOPERATIVE FARM FORESTRY RESEARCH

OHIO PROJECT

Progress and accomplishments in 1949

No further progress was made on the maple syrup study, which was initiated in 1945 and continued through 1947.

Plans for 1950

Present plans call for completing this project with a joint publication of the Department of Rural Economics and the Department of Forestry of the Ohio Agricultural Experiment Station.

IOWA PROJECT

Progress and accomplishments in 1949

No further progress was made on the log-grade yield study during 1949.

Plans for 1950

During the summer of 1950, Mr. Kellogg of the School of Forestry, Iowa State College, expects to complete the analysis of these data and prepare a report for publication.

ILLINOIS PROJECT

Progress and accomplishments in 1949

Publication of The Illinois Veneer Container Industry as Illinois Agricultural Experiment Station Bulletin No. 534 completed this study which was initiated in 1947. In addition, progress was made on the analysis of data collected in connection with the study of the wood requirements of the Illinois coal-mining industry, initiated in 1948.

Plans for 1950

A report on the wood-requirements study mentioned above will be prepared during 1950.

MISSOURI PROJECT

Progress and accomplishments in 1949

Progress was made on the extensive phase of the forest plantation study started in Missouri in 1948. Approximately 230 farms in 18 counties were visited, and 225 sample plots, representing 28 species of trees, were established. Field data were coded and the analysis started.

Plans for 1950

It is expected that the extensive phase of the Missouri plantation study will be completed by June 30, 1950. Continuation of work on other phases of the study will depend upon the availability of funds.

PERSONNEL

(December 31, 1949)

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Growth and Statistical Procedures -- G. Luther Schnur

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Computing -- Lake F. Compton, Margaret K. Piersol, Mary L. Sterner

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AMES BRANCH -- E. Garth Champagne, Kenneth A. Brinkman, Clara C. Mikkelsen
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Paint Creek Experimental Forest -- John E. Krajicek
McGregor, Iowa

BUCKEYE BRANCH -- _____, Robert W. Merz, Richard N. Gaiser, Raymond F. Finn, William T. Plass, Margaret E. Pierson
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Athens, Ohio

NORTHERN OZARK BRANCH -- Franklin G. Liming, S. Clark Martin, Floyd B. Clark, Carol D. McCoy
c/o University of Missouri
Columbia, Missouri

Sinkin Experimental Forest -- Nelson F. Rogers, Wayne M. Harrison
c/o U. S. Forest Service
Salem, Missouri

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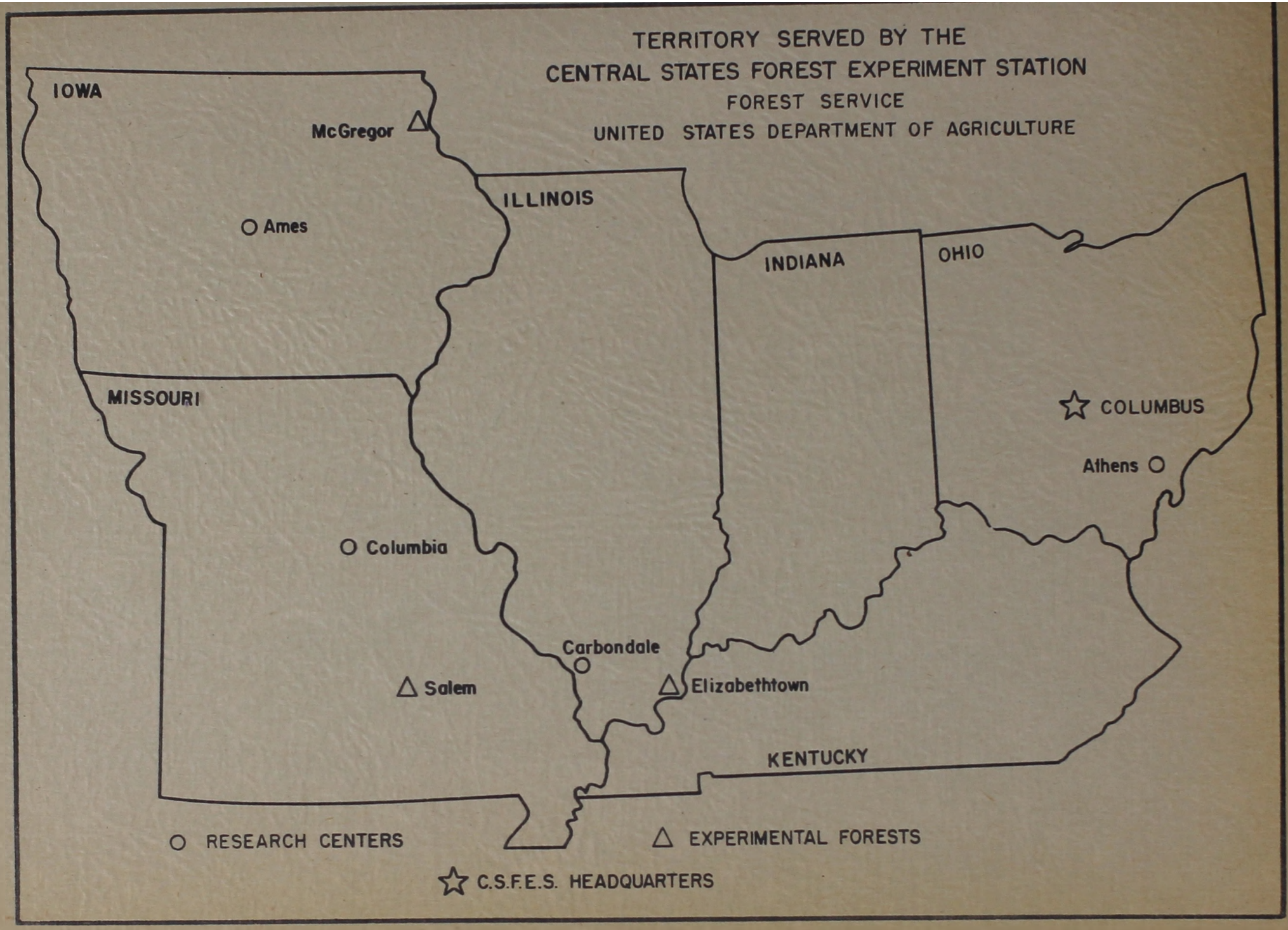
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